epilogue.

essays at the bicentennial of medicine in the united states

u.s. department of health, education, and welfare
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FOREWORD

The National Library of Medicine is pleased to be able to publish three important essays that were prepared and delivered on the occasion of a special Colloquium on the Bicentennial of Medicine in the United States, May 6–7, 1976.

The commentary by Dr. John B. Blake was presented as the historical synthesis of a series of special papers presented at the Colloquium and published in two volumes entitled *Advances in American Medicine: Essays at the Bicentennial* by the Josiah Macy, Jr. Foundation in cooperation with the NLM. The essay by Dr. William N. Hubbard, Jr., was prepared as a dinner address delivered before 200 distinguished leaders of American and foreign science and education within the National Library of Medicine. Dr. Philip Handler's essay, "Quo Vadis, U. S. Medicine?" was prepared as the closing address of the Colloquium and was delivered at the Smithsonian Institution.

Most people examine issues and problems from the viewpoint of the restricted fields of their own endeavors. Few have the time or capacity to cultivate a breadth of interest or experience which allows for a balanced yet penetrating examination of the same issues.

The distinguished authors of these essays have brought together keen and critical observations which should be of great

interest to everyone concerned with medical knowledge and its application within the framework of our past and present societies. Each of the essayists brings to this monograph broad experience and scholarly insights which in the aggregate tell us where we have been, where we are, and where we might be going in the future.

Dr. Blake is a professional historian of international stature who has spent most of his time studying personalities and problems of early American public health. His familiarity with American developments in health and medicine during the 18th and 19th centuries gives real authority as well as substance to his essay.

Dr. Hubbard has had a distinguished career as an internist and medical educator and he now serves as president of one of the nation's largest pharmaceutical firms. His long-standing interest in medical libraries led to his appointment to the NLM Board of Regents for two four-year terms. On each occasion his fellow Board members chose to elect him chairman. His account of the role and function of medical libraries in the modern scene and his profound concern with the utilization of medical knowledge make brilliant and insightful reading.

No individual has had a greater opportunity to examine the successes and failures of American medicine more thoroughly than Dr. Philip Handler. As a scientist and educator at a progressive medical school he contributed to the organization of the modern medical curriculum and as President of the National Academy of Sciences most of the major issues of contemporary medicine have passed before his review.

This writer has been most fortunate to have had a close relationship with each of the essayists: serving with Dr. Blake as a professional colleague at the NLM for 12 years, with Dr. Hubbard as Executive Secretary to the Board of Regents for 8 years, and as a medical student taught by Dr. Handler in 1941–42. Thus, I can vouch for their extraordinary skills, competence, and experience which should make this small volume a rich source of medical history, philosophy, and progress. There is the added dimension of modest prognostication for the future of American medicine.

Martin M. Cummings, M.D.
Director
National Library of Medicine

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The Bicentennial of Medicine in the United States: A Commentary

John B. Blake, Ph.D.

The organizers of this Colloquium have very generously and from my point of view appropriately given to a historian the opportunity to say the last word. They have also presented that historian with the astonishing task of summing up 200 years of progress in American medicine in 20 minutes. Fortunately, you have already heard about many of the advances of medicine since 1776 from a series of distinguished speakers and commentators, all specialists in their respective fields. It would be both superfluous and presumptuous for me to comment in any detail upon the presentations we have all been privileged to hear, and which we will be able to read in greater depth and at leisure in the book based on this Colloquium. I should add that I have had the opportunity to read these chapters, and some of my comments may refer to material that appears in the chapters rather than to what has been said from this podium.

Several themes emerge from the Colloquium as a whole. These may be listed as first, the tremendous growth of scientific knowledge in the last 100 years; second, the great increase in the American role in world medicine as compared with other countries; third, the growing size and complexity of American medical institutions; and fourth, the profound effect of medical science, public health, and more lately therapeutics on the American people and our social fabric. Let us look at these briefly in order.

There is no need to labor the fact that scientific knowledge in nearly all areas of biomedicine has grown tremendously in the last hundred years. One need merely recollect what we have heard these two days about basic and clinical advances in microbiology, immunology, genetics, surgery and other fields. Many of these special fields barely existed 100 years ago. When the first centennial volume of American medicine was compiled in 1876, five papers were thought sufficient. One of the five was on the discovery of anesthesia, undoubtedly the most important American contribution to clinical medicine in our first century. One was on surgery and another on obstetrics and gynecology, areas which have been combined into one paper for this Colloquium. Except for Dr. Billings' paper on "Literature and Institutions," all the rest was covered in one account of "Practical Medicine." [2]

In signalizing the advances of the last hundred years, the speakers have avoided the all-too-human tendency to regard our forebears as unenlightened or, worse yet, stupid because they could not see as well or as far as we think we can see. The knowledge we have acquired in the last 100 years was built on the work of still earlier men. The centennial book on American medicine, seeking to emphasize the accomplishments of our first 100 years, starts out with a story:

> When Boerhaave, the most accomplished and celebrated physician of the 18th century, died, he left behind him an elegant volume, the titlepage of which declared that it contained all the secrets of medicine. On opening the volume every page, except one, was blank. On that one was written, "keep the head cool, the feet warm, and the bowels open."

By 1876, reports the author, Dr. E. H. Clarke, another two or three pages of Boerhaave's book had been filled. This story serves to remind us that physicians of 1876 did not feel that their practice was quite as bad as we tend to believe. Ironically, it also warns us not to fall into the same trap that caught Dr. Clarke, of

denigrating our predecessors to inflate ourselves, for Boerhaave's mythical book of 1776 could have exhibited considerably more than Dr. Clarke was ready to credit it with. For example, to name only three procedures that our speakers have mentioned, it should have listed the use of cinchona bark to treat intermittent fever, fresh fruits and vegetables for scurvy, and variolation to prevent natural smallpox, all of which were known and used with much benefit more than 200 years ago.

We may also note that our speakers in this bicentennial year have not discussed the growth of knowledge of gross human anatomy. There was nothing for them to discuss, for the simple reason that so much was already known 100 years ago. As George Corner has noted elsewhere, anatomists since Franklin P. Mall have turned to embryology, endocrinology, and other areas of experimental biology to save their intellectual souls. [3] With all due respect to the current editors of Henry Gray's *Anatomy,* many of the illustrations in the latest edition look pretty much the same as those in the first, of 1858. Information once hard won tends in time to seem obvious and elementary. It took the genius of a Newton to create the calculus. Now it is taught in high school. As Robert Burton wrote in *The Anatomy of Melancholy* some centuries ago, "A dwarf standing on the shoulders of a giant may see farther than a giant himself."

A second major theme that has frequently emerged in this Colloquium is the increasing role of the United States in the advance of medical science in comparison with the contributions of other countries. This has been brought out quite clearly by our Swedish visitor, Dr. Sune Bergstrom, who has pointed out most generously the increasing percentage of Nobel prizes in medicine and physiology that have been awarded to Americans. Miss Corning and Dr. Cummings have emphasized the increasing percentage of the scientific literature that is published in this country and the growing dominance of English as the language of scientific communication. It is true that as far back as 1802 a German physician, Johann Abraham Albers, began publishing *Americanische Annalen der Arzneykunde, Naturgeschichte, Chemie und Physik* to provide his European colleagues with abstracts and commentaries on the medical and scientific literature of America, but it lasted for only three issues and Sydney Smith's sneering question, "Who reads an American book?" has come to epitomize the status of American science vis-à-vis the rest of the world for much of the 19th century. The real answer to Smith's question,

of course, was quite a few people—and the number increased as the century advanced. Nevertheless, any impartial review of significant advances in medicine and related sciences until about 1890 demonstrates the relative paucity of American contributions.

That this was recognized at the time is apparent from the behavior of those seeking advanced education. As Dr. Cooper and others have mentioned, American medical education was notoriously bad for most of the 19th century. Our universities were only beginning to institute effective reforms as the century drew to a close, first at Harvard under Eliot and then at Hopkins under Gilman and others. The reform did not become general until after the Flexner report. Meanwhile Americans seeking an adequate medical education had gone to Europe—at first mainly to Britain, later to France, and from the 1850s on to Germany and Austria. In his monumental *History of Medical Education,* first published in 1889, Theodor Puschmann of Vienna dismissed the American scene in a page, noting that medical degrees from this country were "regarded with distrust in Europe, and placed in the same category as those amiable but meaningless distinctions which are conferred on people dancing the cotillon."

Nowadays, of course, this is all changed. Previous speakers have cited many individual contributions by American scientists beginning late in the last century—men like Theobald Smith, Walter Reed, William Halsted, and Simon Flexner. Even in the last century America was not merely importing but was also exporting western medical culture to the Orient with Peter Parker and other missionaries, and in this century the United States led in the establishment of western medical schools in China. Since World War II especially, Europeans have come increasingly to this country for advanced study, and if American medical students go abroad in large numbers now, as they do, it is because they cannot find places at home, so great is the demand. America clearly stands as a recognized leader in medical science.

A third theme of the Colloquium has been the increasing size and complexity of American medical institutions, dependent in part upon the growth of science and increasing specialization, but perhaps even more, as Dr. Mider's report has suggested, upon the astronomical growth of federal involvement, first, in medical research through the National Institutes of Health and other agencies, and more recently in the payment for medical care through the Social Security system. Medical schools, hospitals, and insurance systems have become large and pervasive bureaucratic insti-

tutions and the relatively simple physician-patient relationship of 1876 has largely disappeared. The image immortalized by Sir Luke Fildes' famous painting of "The Doctor," despite the AMA's campaign of a few years back, has gone—for which we may be thankful, since all he could do was sit and watch the child die of diphtheria.

This brings us to the fourth theme that emerges from an examination of our first 200 years, the profound effect that the development of medicine and public health has had on the American people. From Dr. Snyder we have learned that 200 years ago the crude death rate was about 35 per 1000. In 1870 it was about 19. In 1970 it was about 10. During the first 100 years, most of the change in age-specific death rates occurred among adults in their most productive period, from about 30 to 60 years, while infant mortality stood still or perhaps even slightly increased. Since 1870, the most dramatic change has been the great drop in infant mortality, but rates for older children and adults have also dropped remarkably. We are now, at least till three score years and ten, a much healthier population. We are also a much older population. In 1765 about 60 percent of the population (in Massachusetts) was below the age of 16. Now less than 40 percent is below the age of 21. People nowadays expect most if not all of their children to outlive them. Two hundred years ago this was the exception.

One should not of course attribute all these changes in mortality to advances in medical science. For example, it could be argued that the invention of the cotton gin has done more for the prevention of typhus fever than anything physicians have done (at least until World War II) by making the large-scale production of short-staple cotton economically feasible, thereby making possible in turn the production of relatively cheap and washable cotton clothing. Increased food supplies and the more varied diet which resulted from better methods of preservation and more rapid transportation, better housing, in short the greatly improved standard of living made possible by the agricultural and industrial revolutions, lay behind the rapid expansion of population in Europe and America from the 18th century on. Without the development of civil engineering, the great sanitary advances of the last 100 years in water supply and sewerage would not have been possible.

How much credit one gives to medical science and how much to other factors seems to depend as much as anything on personal

experience and bias, and I do not believe that any definitive judgment can ever be made. But wherever we may divide the scale, there is surely an important segment, especially since about 1900, for public health and preventive medicine. More recently therapeutics have also claimed a smaller but increasingly significant role.

These demographic changes and other results of medical science have obviously played a very large role in the character of American life through increasing population density, urbanization, family attitudes, personal attitudes toward sickness, and so on. They have brought social problems, such as the greater attention that must be given to care of the elderly. They have brought pressing ethical problems, from abortion to the need for a new definition of death. The dramatic successes of modern medicinals and the spectacular achievements of modern surgery have also brought rising public expectations and demands for health care, further fostered, one must suspect, by sometimes extravagant claims or overly publicized triumphs put forth by Madison Avenue style imagemakers seeking to raise money or increase profits. Perhaps if the public had not been so saturated with information about "miracle" drugs, the feeling might not be as widespread as it seems to be that if the patient is not cured, the doctor is necessarily at fault and subject to suit for malpractice. More importantly, rising expectations have brought demands for more service, better service, but at the time less costly service, demands which have inevitably made medicine during the last few decades one of the persistent concerns of American politics and government.

Several of the speakers in the Colloquium have pointed out to us some of the problems that lie ahead. A number of those problems are essentially scientific ones. No doubt continued research in molecular biology will provide increasing information about cancer cells, as Dr. Shimkin has suggested, and similar results can be expected in other fields, like immunology, genetics, and cardiology. History can give us confidence that if the condition of society permits continued scientific investigation, it will be fruitful of new knowledge.

One cannot but be impressed, however, by the number of speakers who have seen our most important and serious health problems as in one way or another primarily social rather than scientific. I have already spoken of the increasing demands for better health care, more rationally organized and financed. Success in this field will require social and political thinking of the first

order. Other of our most intractable health problems today, especially among the young adult population, may perhaps be helped by the physician and by therapeutics. Victims of automobile accidents, if not killed on the spot, may be patched up and rehabilitated, sometimes by long, painful, and expensive techniques. We are grateful that we have surgeons like Dr. Moore who can do this. Alcoholism and drug addiction can sometimes be controlled. But until we can attack these problems as well as the chronic diseases manifested in older persons by effective preventive measures, as infectious diseases have been attacked in the past, we will not be reaching solutions. These too will require not only the contributions of medical science, but social and political thinking of a high order. They will require means to affect individual behavior within a democratic framework, to educate and motivate people to care not only for the effects their habits have on their own well being but their effects on others.

Dr. Bergstrom and others have suggested that our greatest health problem for the future is population growth. Clearly new drugs, new devices, or new surgical techniques may contribute to the solution, but more is needed. Nearly 200 years ago Malthus posed the problem. His proposed solution was moral restraint, which so far has not proved to be a very practicable one. The problem was to a great degree shunted aside during the 19th century as new agricultural techniques and the opening of new land to agricultural production kept food supplies ahead of population growth, at least in developed countries and except during intermittent disasters like the Irish famine.

Dr. Snyder has remarked that only a few physicians were interested in or contributed toward the solution of this problem early in the present century. I cannot forebear noting at this point that Mark Twain, about 1906, in a passage long suppressed, suggested that doctors had been, but no longer were, one of the chief means on which the world could rely to prevent overpopulation.

> In the past fifty years [he wrote] science has reduced the doctor's effectiveness by half. He uses but one deadly drug now, where formerly he used ten. Improved sanitation has made whole regions healthy which were previously not so. It has been discovered that the majority of the most useful and fatal diseases are caused by microbes of various breeds; very well, they have learned how to render the efforts of those microbes innocuous. As a result, yellow fever, black plague, cholera, diphtheria, and nearly every valuable distemper we had are become but entertainments for the idle hour, and are of no more value to the State than is the stomach-ache.

> What, then, is the grand result of all this microbing and sanitation and surgery? This—which is appalling: the death rate has *been reduced to 1,200 in the million.* And foolish people rejoice at it and boast about it! . . . In time there will not be room in the world for the people to stand, let alone sit down.
>
> Remedy? I know of none.[4]

Nor do I.

As a historian, it is my task to record and interpret the past and not to prophesy the future. Yet it seems to me that the most important message of this Colloquium may be our need to apply the same kind of creative intelligence to social, economic, and behavioral problems of the whole man and the whole society that has had such success in the experimental biology and medicine of the present and the past.

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1. This paper was prepared for oral presentation at the Colloquium on the Bicentennial of Medicine in the United States, sponsored by the National Library of Medicine and the Josiah Macy, Jr. Foundation and held at the National Institutes of Health, Bethesda, Maryland, May 6 and 7, 1976. It is printed here essentially unchanged. The papers referred to are published in full in *Advances in American Medicine: Essays at the Bicentennial,* edited by John Z. Bowers and Elizabeth F. Purcell (New York: Josiah Macy, Jr. Foundation, 1976).

2. *A Century of American Medicine, 1776–1876,* by Edward H. Clarke and others (Philadelphia: Henry C. Lea, 1876).

3. George W. Corner, The role of anatomy in medical education, *Journal of Medical Education,* 1958, *33:* 1–8.

4. Mark Twain, *Letters from the Earth,* edited by Bernard DeVoto (New York: Harper & Row, 1962), p. 91.

The Role of a Medical Library

W. N. Hubbard, Jr., M.D.

The role of a medical library is to improve the utilization of health-related scientific knowledge. The role of the medical library is realized as it acts as translator and communicator between those who produce and those who utilize scientific knowledge. The variety and magnitude of the possible mechanisms by which a library can serve its role transmutes that function itself into a question of the logic of choices of possible mechanisms of action. One extreme interpretation of that role asserts that in any health-related matter there should be a single point of entry into the total store of human knowledge that would conveniently and immediately make available to the inquirer all the information useful to him and none that is redundant. It is now within the technical capacity of medical libraries to respond to such a concept, but any such response should be made with the realization that the pattern of organizational and financial structures that support health related activities does not naturally support such a coordinate function.

In speculating about how to approach an analysis of this plausible yet extreme view, I recalled the essays by Immanuel Kant in 1766 entitled "Dreams of a Ghost Seer." In the third chapter of that volume the following comment is made:

> To yield to every whim of curiosity and to allow our passion for inquiry to be restrained by nothing but the limits of our ability, this shows an eagerness of mind not unbecoming to scholarship; but it is wisdom that has the merit of selecting from among the innumerable problems that present themselves, those whose solution is important to mankind.

To be sure, Kant was addressing his remarks to the metaphysical philosophers of the day. In the context of modern libraries and their role in the utilization of scientific knowledge this quotation is not only a wrenching anachronism but probably is irrelevant. Nevertheless, it contains the enduring truth that those who are devoted to the scholarly life have no less obligation to respond to the immediate problems of the human condition than do those who are committed to the secular world.

The way in which scientific knowledge is used relates only in part to the motivation of its acquisition. No matter why scientific knowledge is acquired, once it is available it becomes a part of the record of human experience. Its use from that point forward need not be restricted by the intentions or circumstances of the originator. However, the form in which the experience of a scientist is recorded is likely to reflect the motivation of the inquiry. There is some utility and a certain distinction in developing arcane languages for specialized publications that are principally addressed to colleagues in a specialized field. It is as if the anticipation of practical use would somehow distort the elegance of the original creative logic. Because the originator need not be interested in or aware of the ultimate uses of his experiences and cannot predict their utility in the future, he usually communicates with peers who have similar motivations for inquiry. The number and variety of such differing motivations and the resulting peer group communications become an impenetrable maze without the ordering role of the library.

I propose that there are three broad realms of motivation for scientific inquiry that correspond roughly to the ways in which scientific knowledge is used. The medical library must address itself to each of these and do so in the terms used by each of the peer groups. The three realms are natural philosophy, then practical application, and finally public policy.

The first realm of natural philosophy is the one in which understanding is improved by knowledge, and like virtue, is its own reward. The motivation for the acquisition and use of knowledge in this realm is the personal interest and curiosity of the individual inquirer. It is a lyrical and idiosyncratic form of endeavor that can be creative. The practice of such pure science as an individual human endeavor is pursued inconsistently over time and erratically from place to place. The underlying cultural and personal qualities that lead to this kind of individualistic inquiry can provide the basic knowledge for applied science, but they are as little understood as the conditions for other forms of creative human endeavor. This first realm of scientific knowledge has the potential of enabling our capacity for civility and humane efforts; but it can also be utilized to disrupt civilization and diminish the humanity of man.

The improvement of understanding through gaining knowledge as an obligation of the educated mind had its origins in the classic traditions of western culture. At the founding of the United States, universal education was the foundation upon which democratic assumptions rested; in recognition of the importance of each citizen's personal and independent utilization of knowledge. An understanding of our scientific origins and of the history of our insights into rational medicine gives us a grasp of the logic of the scientific hypotheses that we use today. An understanding of the history of medical science and practice protects us from the deadly sin of hubris, which assigns value only to the experience of the moment or a single lifetime. Access to accumulated knowledge allows us the privilege of "seeing further by standing on the shoulders of giants." It is a source of justifiable optimism that the history of human affairs is to some extent linear and nonrecurrent. If that linear history is in fact one of successful adaptations, then the idea of progress in human affairs becomes tolerable. It is the originating and continuing role of the library to serve as the means by which the understanding of the current generation is improved by access to accumulated knowledge.

The second realm of practical application of scientific knowledge is an expression of purpose. This is not to suggest that the realm of natural philosophy is either value-free or uninvolved in the general problem of intention. However, the distinguishing characteristic of the first realm is that its goals lie within the personal fulfillment of an individual. The second realm is distinguished by knowledge being applied in order to influence external events.

The most widespread example of this practical application of scientific knowledge is in the process of education. The function of education is not only to transfer information but also to change behavior. It is, in terms of volume, the largest user of scientific knowledge, both for credentialing of the student and for the maintenance of the practitioner's competence. Both the student and the practitioner need the ordering role of the library to translate the specialized knowledge that is originally developed in the realm of natural philosophy into a format compatible with the complex practical problems that they face. Scientific disciplines undergo fission and then continue to subdivide at accelerating rates into a myriad of fields whose problems at any given moment are more likely to be derived from the most recent observation within that field than from any concern with practical application. In this regard, biomedical science itself resembles the expanding universe in its rushing thrust which divides discrete portions of scientific substance from each other.

The application of scientific knowledge that has attracted both the broadest admiration and the most general aversion is the translation of knowledge into technology. The working assumption that anything that can be done in applying science to technology should be done has seemed increasingly inappropriate in recent times; but how to have social constraints on technical innovation without impeding the freedom of inquiry that is essential to improved understanding is not yet clear.

Increases in the effectiveness of services provided by the practitioner depend increasingly on improved technology. For the optimal use of this technology, systems must be developed to provide relevant information to the practitioner in real time for his real problems in the place they occur. A responsibility of the library to serve the producers of the tangible technologies (instruments, equipment, medicinals, etc.) which are utilized by all realms of the health sciences is also clear. What is never clear is the extent to which an agency of government should go beyond the innovation and demonstration of techniques of improved organization and transfer of knowledge into the outright provision of information services. The policy of the central government being a service provider of last resort is sound. What is not evident is how the policy operates with newer electronic and computer technologies. Equity is now obscure—it is to be hoped that any legislative solutions of the copyright issues will not diminish that freedom of access to scientific knowledge that is essential to its

optimum use in the interest of the people.

It is reassuring to recall, as we face what seems to be an autonomous juggernaut called technology, that science is a human experience that probably comes as close to intended action as any human effort can. Because it rests upon human intention, and because technology is *par excellence* an expression of purpose, it becomes clear that technology is not autonomous but is utterly dependent upon the decisions of humans. As we choose the applications of knowledge to technology we may well recall that Francis Bacon, writing in his essay on "Great Place," advised:

> Reduce things to the first institution and observe wherein and how they have degenerated; but yet ask counsel of both times; of the ancient time, what is best; and of the latter time, what is fittest.

It is the first institution of science that it should serve the improvement of the human condition. How to achieve most fittingly that first institution at this time is a continuing challenge to the probity and wit of our society.

The third realm—the utilization of scientific knowledge in public policy—is the most recent and the most disturbing. Scientific knowledge is a source of great power in political advocacy. Daniel Bell has referred to this as "the bureaucratization of knowledge." The political and social importance of technology has given scientific knowledge this extraordinary power. When the scientist becomes an advocate for a public policy he surely is fulfilling a citizen's valid responsibility in presenting the social relevance of his scientific experience; but as an advocate he diminishes the objectivity and relative freedom from conflicting values that distinguish scholarly inquiry. Nonscientists, who usually have the responsibility for decision, may not be able to distinguish clearly between scientific advocacy and scientific understanding. Such responsible decision makers then may proceed misinformed, but full of conviction, to decisions that they think are based on scientific understanding but actually reflect the advocacy of scientists.

The use of scientific knowledge as a tool of advocacy is evident in the political arena, in argument over legal proofs, in the rationalizations used by consumerist groups, and in the documentation of the views of that ultimate expression of intellectual rigor—the mass media. The importance of developing a balance

of power in this utilization of scientific knowledge as a tool of political advocacy implies the need for widespread and equal access for all interested persons to health-related knowledge. This is, in part, the responsibility of the modern medical library.

The biased use of scientific knowledge in advocating the special interests of politicized groups has become an urgent social problem. It is necessary that those in authority *should* be influenced by scientific knowledge, whether their arena is political, legal, consumerist, or even mass media. It is also important that the variety of value systems in each of these arenas should be fostered. It is inevitable, and indeed desirable, that differences of viewpoint and value should be vigorously expressed in order that the democratic process of adaptation to variety can be achieved. The problem occurs when scientific knowledge is available either in a different format, a different context, or to a different degree to the several groups. The process becomes pernicious when those selected bits of scientific description that happen to coincide with a predetermined set of values are culled out of the total fabric of science and used in an advocacy argument as if they were the whole of the relevant scientific knowledge or were at least a balanced representation of it. This abominable abuse of science in the adversary process that characterizes so much of the communication from power centers today—including the institutions of science itself—has done a great deal to contribute to a loss of confidence in the reliability of the affirmative role of science in our society.

The notion that power corrupts does not excuse possession of the power of scientific knowledge from being corruptive. The danger is in the privileged or partial possession of that knowledge. It is in the notion that only the insight of the scientist can interpret the potential or actual social impact of the science. It is in the notion that scientific descriptions are so esoteric and arcane that those uninitiated to the cult of scientists are unable to understand the mysteries and must submit to instruction by scientists. It is in the attacks of scientists upon each other for the sake of their own social values. The correspondence going on today in our journal literature regarding the recent book by Wilson on sociobiology is an example of such value-laden advocacy intruding on scientific inquiry.

The dependable value of scientific knowledge in solving social problems is widely suspect and the institutions of science are increasingly assailed. "Science for the people," "meritocracy as in-

equality," "outcome as the measurement of opportunity," and the growing egalitarian distaste and disdain for exceptional individual achievement are all symptomatic of the public abreaction to the enthronement of science and the willingness of its practitioners to become privileged advocates. The problem today is that the baby of science is in imminent danger of being thrown out with the fluid of his ablutions.

The application of scientific knowledge to public policy advocacy demands equal access for all who are affected by the uses of that knowledge. There is an urgent problem of a lack of the informed consent of our body politic as to how the utilization of scientific knowledge will affect them. Those who would have a central governmental bureaucracy serve as a substitute for the individual's understanding and consent are the enemies of individual freedom and the destroyers of democracy. Those who would increase central governmental authority rather than individual competence deny the faith of our founding fathers that the education of the individual lies at the very foundation of the fulfillment of the democratic ideal. It is characteristic of human history that the democratic ideal is being increasingly sacrificed in the name of the protection of the individual.

The role of the medical library in this problem of equal access to scientific information applied to public policy is the most difficult, the most intimidating, and yet, for the future, probably the most important of the realms of use of knowledge that the medical library should serve. It is an inquiry of the highest order of importance to determine how the library can better fit this new mode of scientific information use. The role of the library is, of course, to serve the purposes of all three realms of utilization of scientific knowledge, but in doing so it must aim to break the walls between them.

The audiovisual and wide band technologies that are available for information transfer give rise to the possibility of a reincarnation of the oral tradition. That tradition can have its capacity and accuracy enhanced without intruding on its original virtues. It is a personal, idiosyncratic, flexible, and lyrical form of communication that is highly responsive to the listener. It was first eroded by the efficiency of writing and more recently by the constraints of printing, but can still be observed in the bazaars of Marrakesh. Our problem today is to avoid making the oral tradition in modern technologic form into a kind of entertainment.

There is also the risk that such electronic forms of information flow will lack the "graven-on-stone" durability that is attributed erroneously to the printed record, but has enchanted those who have published in that record over the years. The formats of the newer technologies are ephemeral, but so as well are all the phenomena of life. There is finally a danger that these new technologies will have such a high degree of predigestion of their substantive contents that whatever intellectual calories remain will be empty.

What is needed, in current jargon, is the research and development necessary to provide a means of outcome analysis of the experience of the *user* to determine whether *his* purposes have been served. It is unfortunate that an outcome analysis of the traditional forms of education in terms of fulfilling user needs has never been achieved so that it is not now possible to have a balanced comparison study. Nevertheless, such an outcome analysis would allow standards of input to be developed that will serve as a stimulus to improved relevance of content to purpose; since those who contribute to the computer-derived and audiovisual materials will be aware that the outcome of utilization will be as much their own responsibility as that of their students.

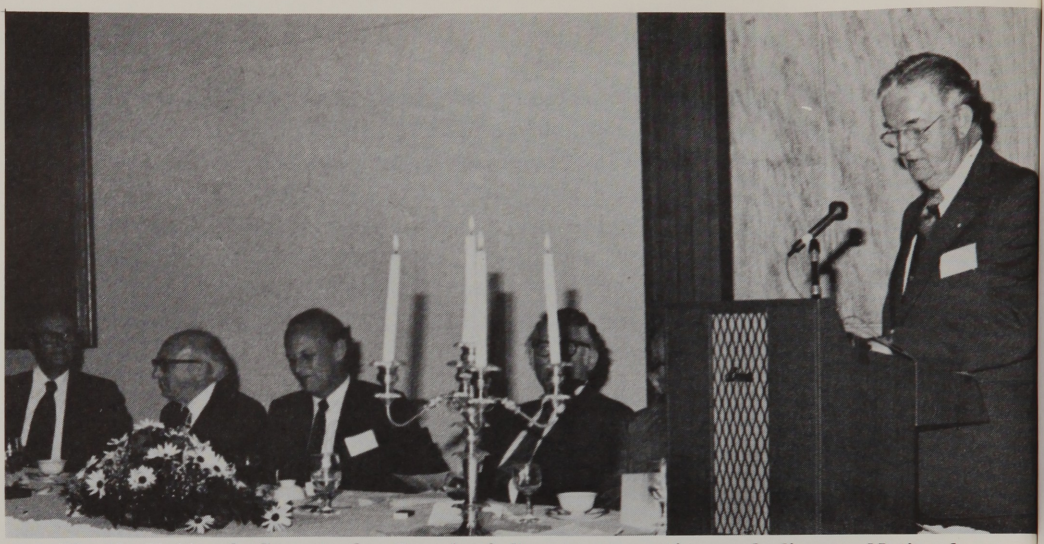
The flexibility of the newer technology lends itself to a system that can utilize one or several data bases for a number of different users; avoiding the almost insupportable cost of providing separate information systems for each special use. Furthermore this system can use networks to create efficient transmission to the point of use. Today prototypes using every mode from satellites to the U.S. Postal Service and from nationwide computer nets to personally tailored browsing are in existence.

The Lister Hill National Center for Biomedical Communications, which is now funded for construction to begin in 1976, will be a unique research and demonstration resource. Through its facilities knowledge will be gained to allow choices of the most fitting uses of the opportunities offered by this new technology.

The medical library of the future will be a university without walls. Such a concept is based upon the high value of individualization of information transfer—a pattern of accessibility and variety of response that has become possible only recently with information transfer techniques and systems that are designed to deal with output in real time in response to real problems. It is a concept of knowledge utilization as participation and responsibility rather than as observation and evaluation. The library is

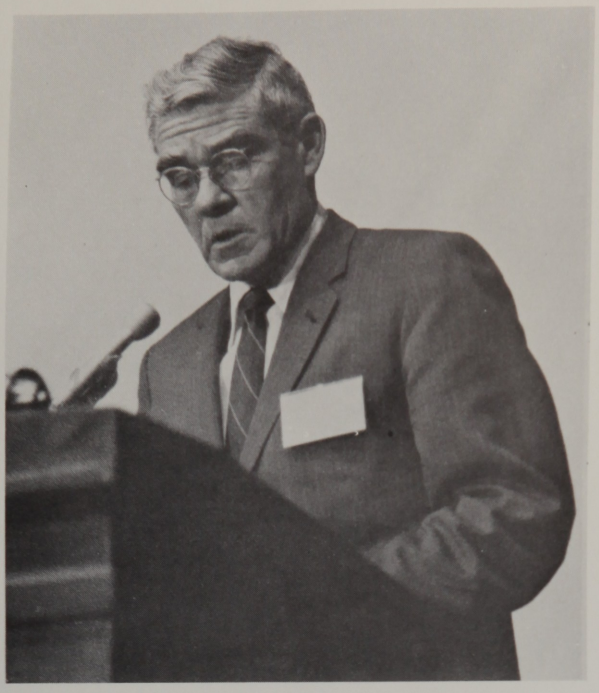
the unique available means by which scientific knowledge, as it relates to health, can be utilized by all who are concerned with health—to the end that scientific knowledge will be the foundation of good judgment in the public interest rather than the weapon of advocacy of special interest. This nation and indeed the world is well served by the contributions that have been made by the director and staff of the National Library of Medicine toward fulfilling the role of the medical library in this most fitting utilization of scientific knowledge.

This paper was prepared for oral presentation at the Board of Regents reception and dinner, National Library of Medicine, May 6, 1976.



Dr. W. N. Hubbard, Jr., at the Board of Regents reception and dinner, National Library of Medicine.

At the Smithsonian Institution's reception, Dr. Philip Handler and Mrs. Handler (center) chat with Miss Mary E. Corning and Dr. Cummings of the National Library of Medicine.



Dr. John B. Blake presenting his Commentary on the Colloquium in the National Institutes of Health's Masur Auditorium.

The Library's main reading room on the night of the Board of Regents dinner.

quo vadis, u.s. medicine?

Philip Handler, Ph.D.

It is with no little trepidation that I come to this podium. When, rather foolhardily, I accepted Dr. Cummings' invitation to be with you this evening, I was unaware of the nature of your program and of the names of the speakers. And the grandiose title advertised for this talk was certainly not of my manufacture. The brilliance of this program assures that there is little anyone can say to put a fitting cap thereon, as it were, and we are aware of the abysmal record of those who would prophesy. But if you will accept a modest correction and allow me to attempt as my subject, "A few small remarks concerning the near-term future of American medicine," I shall try.

Indeed, we do not lack for sweeping reviews or analyses of the overall state of the medical arts or of medical practice. Perhaps it is our Bicentennial, perhaps it is the awesome thought of being part of that system by which 6.5 percent of a one-and-a-half-trillion-dollar-per-year economy is expended for health care —whatever the reason—introspective examinations of medicine appear to have become the fashion.

In a general way, these examinations assume one of two characters. One is the theme which has undoubtedly been dominant at this meeting, viz., to glory in the progress of scientific medicine, particularly in the decades since World War II. The alternate is to assert that the great bulk of the decline in gross mortality rates has had little input from the practice of medicine per se and that, moreover, the most important opportunities for future improvement in the public health will come from changes in our culture, our personal behavior, and our environment—not from the formal system for delivery of health care. The first case is made elegantly by such silver tongued physicians as Lewis Thomas, Ivan Bennett, and DeWitt Stetten. The second case has been argued sadly by Macfarlane Burnet and with rather more gusto by Thomas McKeown.

The reality, of course, is that they are all correct. The public's health is a composite reflection of a given society, a complex integrator of the mores, culture, and economy of the time; while the capabilities and accomplishments of medicine must proceed in train with those of science more broadly taken and with the resources made available by society.

Accordingly our question is not really "Whither U.S. medicine?" It must be "Whither American society?" A brief look at relevant history will help develop the necessary perspective.

Consider the major factors that have contributed to the decline in gross mortality rates in the industrialized world over the last several centuries. Between 1700 and 1900, let us say, mortality rates declined by perhaps 50 percent. This was almost entirely due to decreased mortality from infectious diseases, particularly those that are waterborne or associated with the ingestion of food, although there was also a modest decline in deaths due to some airborne infections as well.

McKeown has advanced the interesting hypothesis that the major single contributing factor was a marked improvement in agricultural productivity with significantly increased supply of nourishing food per capita and at low cost. Undoubtedly the nutrition of most human beings, through most of history, has been marginal. In our time, the consequences of poor nutrition are seen in the poorer tropical "developing nations," where, as compared with well-fed persons, malnourished people are more susceptible to diverse infectious agents and parasites and are certainly more severely damaged by the disease process. An improvement in nutrition in consequence of a more abundant, cheap food supply

could certainly have tipped the evolutionary balance of man and microbe from survival of the parasite to survival of the host.

Although human beings were being closer-packed by urbanization in early industrial society, there was also steady improvement in the quality of water supplies, more efficient disposal of sewage, safer milk, improved handling of food, and greater awareness of the desirability of personal hygiene. The sum of these processes most certainly accounts for a large fraction of the reduction in mortality from infectious diseases that occurred over the course of two centuries, although mortality from non-infectious processes was essentially unaffected.

Early progress in agriculture freed most of the populations of Western Europe and the United States from the ravages of malnutrition. To be sure, the poorest folk of most nations, including our own, are usually malnourished. Wholesale starvation, however, due to famine, has been rare except for the great Irish potato blight. Specific nutritional deficiency disease was confined to a low but steady incidence of rickets, occasional cases of scurvy, outbreaks of pellagra in Spain, Italy, and Romania—the maize-eating southern belt of Europe—plus the four decades when pellagra was the leading cause of death in eight southeastern American states, until fortification of corn meal with nicotinic acid was mandated just before World War II.

Medical measures did not really begin to play a significant role in the decline of mortality rates from infectious disease until early in this century. Thereafter immunization against smallpox, tetanus, and typhoid, antitoxin for diphtheria, surgery for appendicitis and peritonitis, chemotherapy of syphilis, parenteral fluid therapy for the treatment of diarrheal disease and the improved obstetrical care that prevented puerperal sepsis, collectively, decreased significantly the overall mortality from infections—all well before the advent of sulfonamide or antibiotic therapy. This is not to deprecate these extraordinarily powerful and specific agents—we all know how welcome they have been—only to recognize that they are associated with only a small fraction of the total historic decline in mortality from infectious diseases. As an aside, I trust that this Colloquium has taken occasion to note the likelihood that 1976 may prove to be that historic year when the last case of smallpox will have been seen, anywhere on earth —a vast triumph for determined, informed humanity.

Control of *non*infective conditions has accounted only for about one-quarter of the decline in the death rate which has oc-

curred in this century. This has been a rather distributed process; the major components have included surgical management of accidents, surgery for various disturbances of the G.I. tract, maternal and child care generally, and management of the family of endocrine dyscrasias in addition to elimination of acute nutritional disease. Further, during this period, the growth of family planning and contraceptive practice became a major influence on the public health since they assured that the economic gains which made for improvement in health were not lost to sheer growth in human numbers.

It is regrettable that some who have contributed to this historical analysis have also utilized it, in some degree, to deprecate the subsequent accomplishments of the current era of scientific medicine. Interested in the status of the public health rather than in the capabilities of medicine, they argue, correctly, that environmental and cultural practices, not medical care, have been the major historic determinants of the status of personal health. This remains true for that poorer segment of the world's population that does not have access to an adequate food supply and is exposed to a variety of parasitic disorders.

As we have already noted, medical practice—by which I mean the systematic application of procedures developed from understanding of normal function and of the etiology and pathogenesis of disease as well as experimental approaches to therapy —began to affect mortality statistics at about the turn of the century. The movement gathered momentum steadily and then burst forth after World War II. Most of those whom I recognize in this audience have been a part of that remarkable episode; many have made extraordinary contributions thereto. You have been part of a wondrous time in the history of science and of humanity—a period when the liberal political tradition was dominant and was exemplified by public acceptance of science, in an era of wholesale adoption of major new science-bred technologies. Technology, including that of medicine, became responsible not only for our well being, but for the New Enlightenment itself. The greatest contribution to human affairs that science has made is the conviction that the world and its creatures can be understood, that evident problems have less evident causes which can be identified and analyzed, and that intelligent diligence can find solutions—in short, that, by understanding, man can hope to improve both himself and his environment. Recently that faith has seemed to be threatened, but it will surely sustain most of us

gathered here.

Let me speak for a moment concerning the nature of progress in our kind of science.

In the year 1800, the Academy of the First French Republic offered a prize of one kilogram of gold for the best answer to the question, "What is the difference between ferments and that which they are fermenting?" Less literally translated, that would read, "What are enzymes and how do they work?" The prize was never awarded. Had Emil Fischer, author of the "lock and key" theory, almost a century later, submitted a claim to those who originally posed the question, they would surely have been delighted to honor it. But, had he submitted that claim to the Academy of the Third French Republic they would have known, as did he, that he had not yet solved the problem. In the years since, understanding of the mechanism of enzyme action has been approached by successive approximations. A decade ago, the first models of the three-dimensional structure of several enzymes, obtained by X-ray crystallography, seemed at first to expose the total truth. But, again, these have proved not quite sufficiently satisfying to those who wish to understand in the most profound sense, and in detail sufficient to enable successful prediction of the structure of an enzyme that could catalyze some other reaction. And so, this search continues, pursued always by those dissatisfied with the available state of understanding or with their inability to apply that understanding to the specific real world situation with which they are concerned.

And so matters appear to go in medical research more generally. The pattern found in this miniature history of research in enzymology can be repeated with respect to almost every aspect of the structure and function of living systems, and with respect to the etiology, pathogenesis, therapy, or prevention of almost any disease you may mention.

I assume that your distinguished speakers have enlarged upon the details and significance of the great burgeoning of scientific understanding of the human body in health and in disease that most of us in this room have been privileged to witness, in a remarkable era epitomized by the representation of a replicating double helix of DNA on the cover of the announcement of this meeting. But this era, it must be appreciated, could not have occurred earlier, before advances in chemistry, physics, and engineering provided both the intellectual and the technical laboratory tools essential to the enterprise. Progress in biomedical

understanding is best appreciated as a particularly fascinating aspect of progress in general scientific understanding. Nor could it have occurred before the mores of society encouraged these efforts, before society, willing to bear the costs, agreed to the terms of the bond.

It is easily agreed that the net decrease in mortality from applying this new understanding of human biology to treatment and prevention of disease is as yet small by comparison with the enormous earlier gains due to improved hygiene. However, the new gains must be seen as commencing from that base and must be achieved by managing the many diseases that continue to afflict people even after smallpox, measles, scarlet fever, tuberculosis, typhoid, typhus, cholera, yellow fever, malaria, and even syphilis have ceased to be the scourges of mankind.

We take satisfaction in the effectiveness of antibiotics, in the management of endocrine dyscrasias, in definitive surgical procedures as diverse as those for otosclerosis, appendicitis, gallstones, and duodenal ulcer. And we rejoice in the success of drugs that permit the management of hypertension, of depression, of Parkinsonism, of duodenal ulcer, or general inflammation. Elimination of pellagra, polio, and pertussis, diagnosis and treatment of pernicious anemia, erythroblastosis fetalis, and glaucoma, likewise are triumphs of scientific medicine.

Our ablest exponents of scientific medicine have frequently noted the list of disorders for which medicine currently offers neither prevention nor cure but only what Lew Thomas and Ivan Bennett term "half-way medical technologies"—procedures and apparatus which, at great cost, maintain life without fully returning the afflicted individual to himself or to society. Their case is persuasive. They note that it is not the infectious diseases, endocrine or nutritional disorders now under control that drain the health care system but rather vascular disease, the nephritides, neurological disorders, mental retardation, muscular dystrophy, arthritides, most forms of cancer, the major psychoses, and genetic disorders—for all of which we lack definitive procedures.

The major lesson of the recent past is that whereas clinical success comes with understanding, the specific clues that will open up such understanding are not readily predictable. The massive continuing effort to gather detailed understanding of the multifaceted manifestations of life has been prodigiously successful, and as a description of ourselves, entirely worthy in its own right. From time to time, a small grain of understanding unexpectedly

appears to be critical to the improvement of one or another clinical procedure. How could one know that the acetyl choline receptor found in the electroplaques of Torpedo would prove to be essentially identical with the antigen in the auto-immune process which gives rise to myasthenia gravis? Or that the serum of the horse-shoe crab is an essential tool required for understanding the process of infection by anaerobes?

We must continue in our poetic search for self understanding, aware that this understanding is its own reward, aware that some of our most vaunted technologies are limited—witness the retinopathy and renal disease of the diabetic and the fact that, a half century after the discovery of insulin, one can offer no credible hypothesis concerning the molecular mechanism of its action—but keenly aware that fundamental research remains the only hope for successful approach to a host of frustrating disorders which are so destructive of human lives.

For those so engaged such research may seem to be a marvelous intellectual game which, measured in human terms, has happily yielded a wondrous harvest. And those who have played the game share, as an article of faith, the belief that the best is yet to come. But we must guard against impatience. What remains yet to be investigated exceeds in scope, complexity, and experimental difficulty all that has gone before. Given the current human condition, I see no reason to believe that the fruits of research tomorrow will be any less applicable to major problems in human biology than were those of yesterday. Whereas if we fail to prosecute such research, we condemn those unborn to grief and suffering.

Moreover, great gains in health by preventing disease are still possible from cultural alterations in our behavior and from governmental manipulation of the environment—quite apart from future successes certain to occur in the development of medical technology. McKeown has suggested that the application of science to human affairs has been misconstrued as it is applied to health. Whereas it has been interpreted to mean that we are *ill* and are made *well,* he and others argue that it would be nearer the truth to say that we are *well* and are made *ill* by our technological civilization. I believe this to be no more than a half-truth. But I agree that each person now has the opportunity to improve his own health.

If one is fortunate enough to have been born free of congenital disease or disability, and to have an income which meets

the cost of essentials, then, it is proposed, by controlling one's behavior one can do much to preserve health and extend life, without recourse to the preventive or therapeutic practices associated with medicine. Heavy smoking, consumption of refined foods and alcohol, and sedentary living are profound departures from the conditions under which man evolved; their consequences in vascular disease, lung cancer, and cirrhosis, it is argued, account for a significant fraction of current mortality which could be markedly reduced by altering one's own behavior. Further, it is noted, if to this list were added rigorous enforcement by government of speed limits on the highways, and a vigorous program to protect the air, water and food against pollutants known or suspected to be health hazards, there could then be effected a substantial decrease in gross mortality rates from accidents, diverse forms of cancer, pulmonary and other diseases, as well as an improvement in the general quality of life. I agree.

What we might well hope for is an improvement in the health of normal adults, with prolongation of that period of life which is relatively disease-free, thus liberating the health services system to concern itself with the congenitally handicapped, with acute disorders of childhood, and with those diseases of the midyears which would still remain outside our control, as well as with psychiatric and geriatric practice.

But accomplishment of these goals must entail a very large social and political effort. It is painfully clear that mere exhortation has little effect on those engaged in drug abuse, be it alcohol, nicotine, or opiates, perhaps because we have, unconsciously, transferred responsibility for our own health to the health care system. A major social effort, without precedent, is required to achieve this goal and to encourage the return to a relatively spare existence, avoiding overweight and partaking regularly of exercise.

There is nothing novel in awareness of the intrinsic desirability of such a personal program—but personal habits, so far, have been very little affected by such awareness. Since other aspects of our culture are dominant, some form of public intervention must be required. Although the goal is improved health status, since those involved are still healthy, they are not accessible to the established health care system. Therefore some other arm of society must mount this program if it is to be effective.

With respect to the effort to remove offending materials from the physical environment, again, although the goal is health, the

effective instrument must be other than the health care system. The task of protecting man from damage by unnecessary attack by chemicals in the environment is a theme of our day, but it is not clear what the ground rules are or should be. In the future, introduction of a new chemical compound into the environment will not be acceptable unless it has first been determined that such action is "safe." But there is the rub. How safe? And how will we know?

We live in a time of rampant "chemophobia," an understandable reaction to a prolonged era when the health consequences of industrial practice were given relatively short shrift. Apparently, all chemicals in the environment are now to be considered potentially guilty of something—until proven otherwise.

Implementation of this philosophy is expensive and difficult. Testing programs, to be adequate, must be extraordinarily comprehensive and utilize a sufficient number of animals of diverse species in a battery of assays. Arranging for them, conducting them, paying for them, and interpreting them will be a massive endeavor. And there are serious intellectual problems, such as translation of such experimental data concerning animals into useful regulations with respect to human exposure. At its simplest, this poses the inevitable problems of scaling up to humans from smaller laboratory animals; at its worst, one may challenge the validity of any presupposed analogy between the response of man and some other species to a foreign chemical compound.

In a general way, there is no reason to tolerate the presence of known carcinogens in the environment, unless the material in question is absolutely vital to the economy in some way (for example, butadiene and styrene, the ill effects of which would probably not have been detected by any imaginable screening system). In such instances, the problem will be to minimize exposure. That means confronting the question of whether or not there is an *effective* threshold exposure dose for a carcinogen below which, in effect if not in theory, it ceases to be carcinogenic.

There is a school of environmentalists that argues vehemently against this notion, suggesting that a single molecule may actually prove to be carcinogenic. But this is surely an untenable position, taken by those who do not recall the Avogadro number, and the argument should not foolishly be utilized to deny to society the benefits of an otherwise truly useful agent—as we have probably already done by banning diethylstilbestrol (DES) in cattle feed

and DDT as a general purpose insecticide. The time has come to stop using naive language, such as the word "safe." We should systematically gather sufficient information to formulate risks and costs in quantitative terms in order to place them in perspective with perceived benefits.

Perhaps the most pressing problem is quantifying the actual contribution of environmental factors to the incidence of neoplastic disease. Current estimates, of the order of 75 percent, rest not on summary of the expected consequences of public exposure to known chemical carcinogens but on broader epidemiological considerations. It is unclear to me what fraction of environmental carcinogenesis is contributed by discrete, specific chemicals that result from our technologies. And this must be known if the costs of their removal from the environment are to be appraised against the benefits—unless our society really does place a value of $-\infty$ on the very fact of carcinogenesis.

Control of emissions from automobiles and stationary power plants and the establishment of standards for water quality are examples of major exercises of this sort of regulatory activity for which adequate substantiating data do not exist. In each case very large economic forces and huge dollar costs are involved. The latter are not seen to be chargeable to the national health bill but to the consumer bills for the individual products, else it is doubtful that such regulation would be put in place. This great social upheaval is to be fought and accomplished finally in the courts, decision by decision. How those decisions are to be made will surely depend in large measure on "the temper of the times" —the current strength of opinion—as well as on "scientific fact."

But what will happen to the health care system, meanwhile? What does all this mean to tomorrow's physician? His profession will be even more demanding than in the past. If the social effort described is successful, the general nature of medical practice would be much modified—as we have already noted. The physician will have available much more powerful analytical tools. (It is to be hoped that an increasing fraction of these will be based on non-invasive techniques.) Surely, he will regularly have much more information concerning his patient than he has had in the past. And he will have available to him more powerful, more specific, and, hence, more dangerous, tools and procedures than ever before. That will be particularly true if, within that armamentarium, there is included a battery of drugs whose chemical structures are closely tailored so as to lodge on specific biological

receptors of known three-dimensional conformation. Such compounds will, one day, be the drugs *par excellence*—e.g., the natural binder to the morphine receptor—but they may be used only under the most appropriate circumstances and handled with exquisite care. Only a very competent scientist cum physician need apply!

The setting in which the physician operates, the medical care system itself, will be undergoing continual change not as an isolated phenomenon but molded by a society which is itself evolving under the pressure of forces which are relatively poorly understood. The mores of the health care delivery system have traditionally been established by medical practitioners. That day is passing. The norms for medical practice will be established by the changing values of the larger society itself, as already reflected in the pressure for environmental protection. It is seen also in the rising public interest in such matters as "death with dignity," fetal research, studies of genetic inheritance of diverse human traits, and in the imposition of ethical rules governing the conduct of research itself.

We lack means of resolution when two different values of the society result in behaviors that, themselves, come into conflict, analogous to the internal constitutional conflict between assuring freedom of the press and the right to a fair trial. This is evident in the growing objection to the use of prisoners for the study of drug metabolism in the face of more rigorous requirements for such information before licensing drugs; in the recent order that prisoners at Lexington, Kentucky may not be used for studying the metabolism of drugs of abuse, when there is no place else for such studies; in restrictions on the use of fetuses for research, etc. As Carl Djerassi has noted, it is impossible to develop a new oral contraceptive in the United States. Again, therefore, ultimate resolution of these conflicts must occur in an unprepared judicial system. And we must reconcile ourselves to the fact that our society will be uncomfortable regardless of how each such decision turns out.

Finally, the major social issue before us is the manner and extent to which we will assure all citizens of equitable access to the health care system. This debate continues. Mandated third party insurance has great attraction for politicians since the government then takes credit for the action, yet without financial exposure—but this would probably also fail to protect substantial segments of the public such as the poor, the unemployed, the

aged. On the other hand, proposals to fund health care delivery through the Social Security system evoke all of the usual objections to the intrusion of bureaucracy into the health care system. The outcome, for some time, may be decided by the winner of the 1976 Presidential election.

Although it is facile to state that our almost embarrassingly rich nation must soon demand arrangements that will assure all Americans, independent of means, equal and equitable access to the health care system, it is unlikely that there is any general willingness to increase further the fraction of the total GNP devoted to the operation of the health care system. The health care system has grown luxuriantly for several decades both in absolute size and as a fraction of the GNP; it is surely about to encounter very serious restraints to further growth. This is evident in the murmurs of unease with the scale of payments for the Black Lung Disease program, and for support of renal dialysis programs, as well as in complaints concerning the size of premiums for Blue Cross/Blue Shield.

The health care system is not unique but, rather, is typical of the problems now faced by various major social systems. The situation is comparable to the limits to be placed on the entire society by the limitations of the supply and costs of energy—after we had built a society characterized by profligate consumption of energy. The complexities and limitations of the social system for medical care are paralleled by the complexities of the educational system, the transportation system, and the housing system. And so, this is an age of reckoning, of constructing the future by allocating resources.

One should not misinterpret the growing sense of bewilderment concerning our inability to use technological advance to solve the problems of these social systems. It is true that there is a growing skepticism—concern that attempts to apply advanced technology to these systems simply accentuate the problem of cost and exaggerate their depersonalization. Some lay the problems of each of these social systems at the feet of technological advancement itself. But these perceptions are the consequence of changing personal value systems, of our ever-rising expectations with respect to the quality of life and demands upon the services that make for that quality of life, colliding with the reality of limited resources in a finite world.

I cannot say what fraction of medical care will be managed by specialists or by the specialized deliverers of primary care, by

clinics, or by whatever we will mean by a "hospital" tomorrow. Nor is this the occasion on which to discuss the several questions concerning medical manpower. I am confident that the capability of that health care system to deal with the biological aspects of the human problems that parade before it will continue to improve and that this will be made possible by continuing progress and sophistication of biomedical research. Would that I could be as sanguine concerning the social, economic, and political aspects of these problems.

As you leave this evening, perhaps briefly pondering these matters, I commend to you a remarkable piece of wisdom, found in a book on labor-management relations, written by Wellington and Winters:

> To look for solutions to these difficult social questions is profoundly to misunderstand their nature. The quest is not to solve but to diminish, not to cure but to manage; and it is this hard truth that makes so many frustrated, for it takes great courage to surrender a belief in the existence of total solutions without also surrendering the ability to care.

This paper was prepared for oral presentation at the closing address of the Colloquium and was delivered at the Smithsonian Institution, May 7, 1976.

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